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Quality of life after elective cardiac surgery in elderly patients

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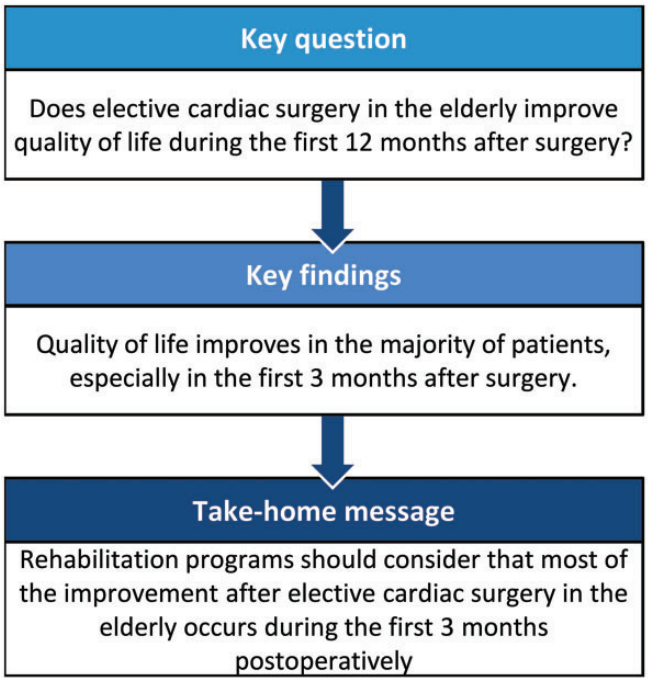

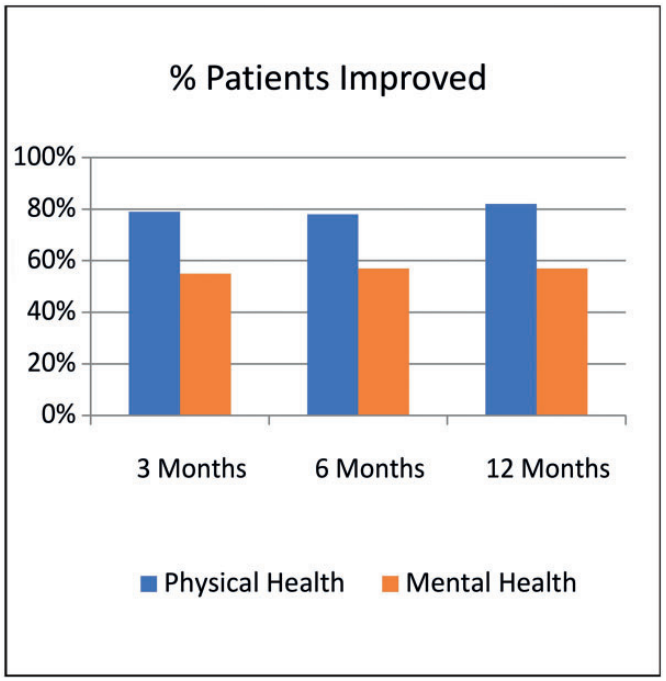

Abstract

OBJECTIVES: Cardiac surgery has little effect on life expectancy in elderly patients. Thus, improving the quality of life should be the main factor affecting therapeutic decisions. Most studies on quality of life in elderly patients undergoing cardiac surgery report improvement but have limitations. Consequently, we assessed improvements in the quality of life of elderly patients undergoing elective cardiac surgery, identified influencing variables and established patterns of mental and physical health variations in the first year postoperatively.

METHODS: We conducted a prospective study of patients aged 65 or older who underwent elective cardiac surgery between September 2011 and August 2013. The 36-item Short Form (SF-36) surveys were obtained preoperatively and at 3, 6 and 12 months postoperatively.

RESULTS: The 430 preoperative patients with a mean age of 74 years (SD 5.5 years) comprised 220 men. Most physical health improvements occurred within 3 months and continued to improve significantly until 12 months. Predictive variables for patients showing less improvement were poor preoperative physical health, female sex, older age and longer length of hospital stay. Mental health improved significantly through the third postoperative month. The negative predictive variables were poor preoperative mental health and longer intensive care unit stay.

CONCLUSIONS: Most patients improved both physically and mentally after surgery, and most of the improvement occurred within 3 months post-surgery. These improvement patterns should be taken into account when creating rehabilitation programmes, and patients should be counselled on what improvements can be expected during the first 12 months after surgery.

Keywords: Quality of life • Elderly • Cardiac surgery

INTRODUCTION

The Organization for Economic Co-operation and Development defines elderly people as those aged 65 or more [1]. This population group is growing worldwide in both number and percentage and currently accounts for 18.7% of the Portuguese population. The number of elderly patients undergoing cardiac surgery has also increased, accounting for more than 50% of the total number of patients undergoing cardiac surgery [2].

Many studies suggest that cardiac surgery can be performed safely in elderly patients with acceptable mortality and morbidity; however, these results were obtained from selected groups [2, 3]. There are studies with highly selective cohorts where the survival rates are similar to those of the general population of the same age [4]. The objectives of cardiac surgery are to increase the survival rate of patients and improve their quality of life. In elderly patients, cardiac surgery has little effect on life expectancy, as most patients have nearly reached their life expectancy; consequently, an improvement in the quality of life is of greater importance [5, 6].

Most published studies on quality of life in elderly patients undergoing cardiac surgery show a significant improvement in the quality of life. These studies have several limitations such as varying definitions of elderly, a lack of quantitative results and the inclusion of urgent procedures, which are normally associated with poorer outcomes and mortality [5, 6]. These data suggest the need for prospective studies that focus on patients undergoing elective procedures using validated, reliable and reproducible measures of quality of life, such as the 36-Item Short Form (SF-36) Survey [5, 6]. Some authors have suggested that studies on quality of life should include preoperative evaluation, definitions of their inclusion and exclusion criteria, the percentage of missing data, justification for why data were missing and how data were interpreted [7]. Studies using correct methodologies may conclude that some patients currently considered as ineligible for surgery can actually be operated on and benefit from the intervention [8].

Considering the importance of quality of life in this group of patients and the limitations of previous studies, we undertook a prospective study to determine whether there is an improvement in the quality of life in elderly patients after elective cardiac surgery and investigated which variables influence it. As a secondary objective, we evaluated the patterns of mental and physical health variations during the first year postoperatively.

METHODS

We conducted a prospective quality-of-life study in patients undergoing elective cardiac surgery from 1 September 2011 through 31 August 2013. Patients aged 65 years or older who underwent elective coronary artery bypass grafting surgery, valve surgery or combined coronary artery bypass grafting surgery and valve surgery were included. The indications for surgery in the patients of our sample were the guidelines published by the European Society of Cardiothoracic Surgery and the American Heart Association [9, 10]. The patients who underwent urgent and emergent procedures were deliberately excluded. Clinical data were collected from our department database, and variables were defined according to the Society of Thoracic Surgery. The mortality risk was calculated with EuroSCORE I [11]. The study was approved by the hospital's ethics committee, and all included patients gave their informed consent.

The evaluation of quality of life was done with the SF-36 test, which was previously validated for the Portuguese population [12]. This test evaluates 8 dimensions of general health: physical function, role-physical, bodily pain, general health, vitality, social functioning, role-emotional and mental health. These 8 dimensions were aggregated using a validated algorithm in 2 summary components: physical and mental [13]. Patients answered the questionnaire in the evening prior to surgery and again at 3, 6 and 12 months postoperatively. The questionnaires were administered via face-to-face interviews and, when that was not possible, via telephone interviews. Quality-of-life data collection ended on 31 August 2014. The missing data were corrected with mean value incorporation of each question, as recommended by the SF-36v2 administration guide [14].

Statistical analysis

The variables were described by means and standard deviation (SD). Normality was tested with the Kolmogorov–Smirnov test. The comparison of the 8 SF-36 dimensions with the 2 summary measures at the 4 established times was done with the non-parametric Friedman test, and multiple comparisons were made afterwards using one-way analysis of variance. Before one-way analysis application, we made a rank transformation of the data, which accounts for the issues associated with variables with non-normal distribution.

Simple linear regression considered the beta value, *t*-value, significant *P*-value of 0.05 and determination coefficient (R^2). The variable selection for the model was made by both stepwise and backwards methods. The normality and homogeneity were characterized by a graphic analysis, and the independence of residuals was validated with the Durbin–Watson statistics. Multicollinearity was assessed with the variance inflation factor. Statistical calculations were done with SPSS version 18 ® for Windows (SPSS Corp., Chicago, IL, USA).

RESULTS

The preoperative sample consisted of 430 patients. Twelve months post-surgery, this number was reduced to 384. Three months post-surgery, only 402 patients answered the survey because 22 patients had died, 5 were hospitalized, and 1 showed cognitive dysfunction. Six months post-surgery, the group consisted of 390 patients. Seven had died, 4 were hospitalized, 1 was abroad, and 1 refused to answer the survey; however, 1 patient who remained hospitalized 3 months post-surgery answered the

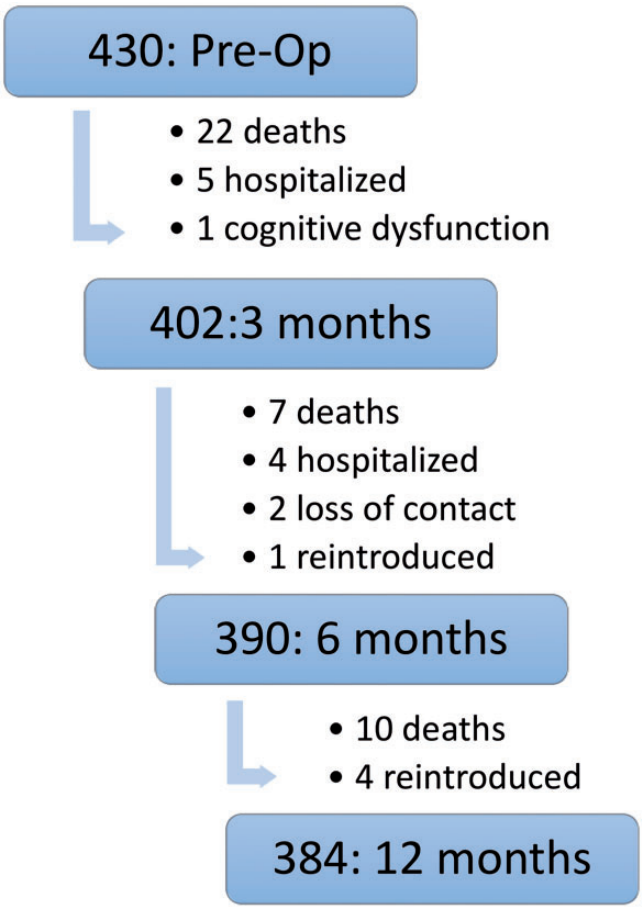

Figure 1: Flow chart of patient data. Hospitalized (in hospital), cognitive dysfunction (confused could not answer the test) and reintroduced (in hospital at the previous evaluation time but could answer 36-item Short Form questions following discharge).

survey. Twelve months post-surgery, there were 384 patients remaining, as 10 had died. Four patients who remained hospitalized 6 months post-surgery answered the survey (Fig. 1). At this final follow-up, 1.8% of the questions on the SF-36 were missing.

The mean age for the initial sample of 430 patients was 74 years (SD 5.5). Population characteristics are summarized in Table 1.

The mean EuroSCORE I was 5.96% (SD 4.15), the mean length of hospital stay was 9.44 days (SD 5.58), and the mean intensive care unit (ICU) stay was 3.2 days (SD 4.52). The mortality rate at 30 days post-surgery was 3.9% (17 patients), and the 1-year survival rate was 90.8% with 22 late deaths.

Quality of life

Figure 2 shows that 61–85% of patients improved in all dimensions, and 4–26% of patients remained unchanged; 12–26% of patients worsened in various dimensions. Table 2 shows the number of patients with improvement or worsening of the composite physical and mental components 12 months after surgery.

Table 3 reports the median and percentiles (25 and 75) for the 8 dimensions of the SF-36 at the 4 time points. Figure 3 illustrates the evolution from the preoperative phase through 12 months after surgery. The last column of Table 3 and the graph in Fig. 3 show that most of the improvement was observed in the first 3 months after surgery.

Table 1: Demographic data

	n (%)
Sex	
Male	220 (50.9)
Female	213 (49.1)
Angina CCS	
0	5 (1.2)
I	231 (53.3)
II	154 (35.6)
III	42 (9.7)
IV	1 (0.2)
Dyspnoea NYHA	
I	25 (5.8)
II	203 (46.9)
III	204 (47.1)
IV	1 (0.2)
Hypertension	
Yes	395 (91.2)
No	38 (8.8)
Hypercholesterolaemia	
Yes	357 (82.4)
No	76 (17.6)
COPD	
Yes	39 (9)
No	394 (91)
Smoker	
Yes	108 (24.9)
No	325 (75.1)
Ejection fraction	
Good	347 (80.1)
Fair	79 (18.2)
Poor	7 (1.6)
Procedure	
CABG	111 (25.6)
CABG and valve	43 (9.9)
Valve	279 (64.4)

CABG: coronary artery bypass grafting; CCS: Canadian Cardiovascular Society; COPD: chronic obstructive pulmonary disease; NYHA: New York Heart Association.

Statistical analysis

We applied the Kruskal–Wallis test to evaluate whether there was a significant difference in the preoperative results of the 8 dimensions between procedures. Only on physical function, there was a significant difference, and multiple comparisons evidenced that patients programmed to valve surgery had better results ($P < 0.05$). We analysed the evolution of the 8 dimensions of the SF-36 throughout the first year after surgery, considering the 4 time points at which the test was completed. Normality was rejected for all 8 dimensions ($P < 0.001$). The Friedman test showed a significant difference for all dimensions at 1 or more of the time points ($P < 0.001$). Multiple comparisons of the 8 dimensions at the 4 time points showed that the results at 3, 6 and 12 months were significantly better than those obtained preoperatively. The comparison between Months 3 and 6 showed a significant improvement in physical function, role-physical, bodily pain, social function and role-emotional but no significant differences in general health, vitality or mental health. The comparison between Months 6 and 12 showed a significant improvement only in

bodily pain. No significant differences were found in the other 7 dimensions. The last column of Table 3 suggests that between 84% and 100% of the improvement for all dimensions occurred from the preoperative phase until 3 months after surgery.

The analysis of the summary measuring 'mental and physical components' was also addressed using multiple comparisons. In the physical component, there was a significant improvement during the first year after surgery: preoperative to 3 months ($P < 0.001$), 3–6 months ($P = 0.02$) and 6–12 months ($P = 0.001$). In the mental component, there was a significant improvement only from preoperatively until 3 months after surgery ($P < 0.001$). We found no significant improvements from Months 3 through 6 ($P = 0.19$) or from Months 6 through 12 ($P = 0.36$).

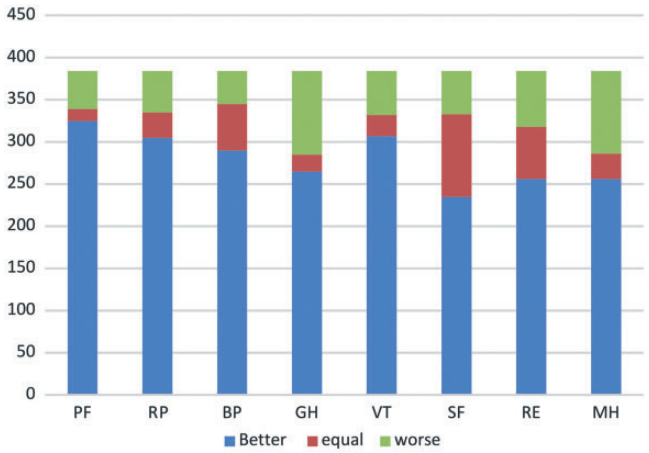

Figure 2: Quality-of-life changes after the procedure according to the results of the 36-item Short Form test. BP: bodily pain; GH: general health; MH: mental health; PF: physical function; RE: role-emotional; RP: role-physical; SF: social function; VT: vitality; *Y*-axis indicates number of patients.

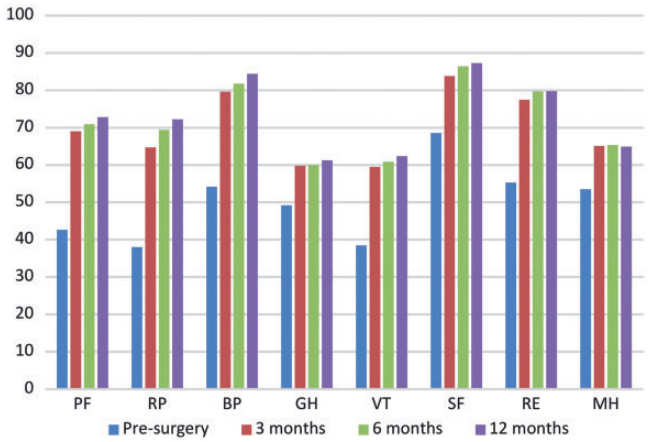

Figure 3: Variations in the results of the 36-item Short Form test up to 12 months after surgery. Mean (36-item Short Form) scores for pre-surgery, 3, 6 and 12 months after surgery. BP: bodily pain; GH: general health; MH: mental health; PF: physical function; RE: role-emotional; RP: role-physical; SF: social function; VT: vitality; *Y*-axis indicates percentage of patients.

Multivariate analysis

We conducted a multivariate analysis with linear regression. We considered both the physical and mental component results at 1 year as the dependent variable. In the univariate evaluation, we tested the following variables: preoperative physical and mental component results, sex, age, procedure, education level, earnings, EuroSCORE I, body mass index, the New York Heart Association and Canadian Cardiovascular Society class, ICU stay and the total length of hospital stay. We identified the following significant predictive variables: preoperative physical component [$\beta = 0.195$; $t(379) = 3.912$; $P < 0.001$], sex [$\beta = 0.192$; $t(379) = 3.83$; $P < 0.001$], age [$\beta = -0.18$; $t(379) = -3.771$; $P < 0.001$] and length of hospital stay [$\beta = -0.098$; $t(379) = -2.071$; $P = 0.039$]. The equation for the physical component obtained was as follows:

Physical component (12 months) = 53.204 + 0.165 preoperative physical component +0.734 male − 0.075 age -0.058 length of hospital stay

This model explained 16.5% of the variability of the physical component at 12 months after surgery and 18.2% if severe outliers were excluded.

For the mental component, we analysed the same variables as the predictors and concluded that only the mental preoperative component [$\beta = 0.0.192$; $t(381)3.849$; $P < 0.001$] and ICU length of stay [$\beta = -0.126$; $t(381) = -2.526$; $P = 0.012$] were significant predictive variables. The equation for the mental component obtained was as follows:

Mental component (12 months) = 49.283 + 0.138 preoperative mental component -0.078 ICU length of stay

This equation explained 5.2% of the mental component variability and 6.1% if severe outliers were eliminated.

Our equation can explain 18% of the variance in the physical component, which is a low value. In the mental component, it explains only 6.1% of the variance, which is weak, and we can thus conclude that the variables that could explain it have not been included in our model.

DISCUSSION

Our study aimed to evaluate the health improvement of elderly patients who underwent elective cardiac surgery for up to

Table 2: Changes in the outcomes of physical and mental components 12 months after surgery

	PC worsened, *n* (%)	PC equal, *n* (%)	PC enhanced, *n* (%)	Total, *n* (%)
MC worse	10 (3)	8 (2)	87 (23)	105 (27)
MC equal	3 (0.7)	9 (2)	49 (13)	61 (16)
MC enhanced	25 (7)	14 (4)	179 (47)	218 (57)
Total	38 (10)	31 (8)	315 (82)	384 (100)

MC: mental component; PC: physical component.

Table 3: SF-36 results

	PO	3 Months	*P* (PO-3 months)	6 Months	*P* (3–6 months)	12 Months	*P* (6–12 months)	(3 Months-PO)/(12 months-PO)
PF	40 (25–60)	75 (55–85)	*P* < 0.001	75 (58–90)	*P* = 0.02	80 (60–90)	*P* = 0.07	86%
RP	31 (19–50)	75 (50–82)	*P* < 0.001	75 (50–100)	*P* = 0.01	75 (50–100)	*P* = 0.15	76%
BP	51 (31–74)	94 (62–100)	*P* < 0.001	94 (62–100)	*P* = 0.003	100 (74–100)	*P* = 0.04	87%
GH	46 (35–60)	62 (50–72)	*P* < 0.001	62 (50–72)	*P* = 0.77	62 (50–77)	*P* = 0.14	92%
VT	38 (25–50)	63 (50–75)	*P* < 0.001	63 (50–75)	*P* = 0.23	63 (50–75)	*P* = 0.08	88%
SF	75 (50–88)	88 (75–100)	*P* < 0.001	100 (75–100)	*P* = 0.005	100 (75–100)	*P* = 0.44	84%
RE	50 (25)	75 (67–100)	*P* < 0.001	79 (75–100)	*P* = 0.04	83 (67–100)	*P* = 0.88	92%
MH	55 (40–65)	65 (55–75)	*P* < 0.001	65 (60–75)	*P* = 0.52	65 (55–75)	*P* = 0.37	100%

[a]Values are expressed as median and (25th–75th percentile).

[b]*P*-values for multiple comparison one-way ANOVA.

BP: bodily pain; GH: general health; MH: mental health; PF: physical function; PO: preoperative; RE: role-emotional; RP: role-physical; SF: social function; SF-36: 36-item Short Form; VT: vitality.

12 months after surgery. We found that the majority of patients improved in both mental and physical health. We found a significant improvement in the 8 dimensions of the SF-36 at all postoperative time points when compared with the preoperative data. Most of the improvement was observed at 3 months after surgery for each dimension, varying between 76% and 100% of total improvement. In the physical component, there was a significant improvement up to 12 months after surgery; however, most of the improvement took place in the first 3 months. In the mental component, there was an improvement at 3 months after surgery and no significant change thereafter; 61–85% of the patients improved in each dimension, and 10–26% of the patients worsened. With respect to the physical component, 315 patients (82%) improved, and 38 patients (9.9%) worsened. In the mental component, 218 patients (56.7%) improved, and 105 patients (27.3%) worsened at 12 months after surgery. Taking the physical component at 12 months after surgery as the dependent variable in the multivariate analysis, the positive predictors were higher preoperative physical component results and male sex. Negative predictors were older age, female sex and a longer hospital stay. For the mental component, the positive predictor was a better preoperative mental component result, and the negative predictor was a longer ICU stay.

The patients in our sample improved in all of the SF-36 dimensions, unlike those in most previous reports [15, 16]. We confirmed the results of the study performed by Falcoz *et al.* [17], in which a group of patients undergoing elective surgery showed an improvement in all dimensions 1 year after surgery. A study performed by Petersen *et al.* [18] that had a 6-month follow-up reported an improvement in the mental component up to 6 weeks after surgery, after which there were no significant changes. Petersen *et al.* [18] also found a continuous significant improvement in the physical component up to 6 months after surgery. Our study shows comparable results; however, our postoperative follow-up period was longer, and we suggest that the physical component continues to improve for a small but significant time period from 6 to 12 months, while the mental component remains unchanged. Different studies report different percentages of patients whose physical and mental health improve, as measured by the SF-36. Welke *et al.* [19] reported an improvement in physical health in 73.3% of patients, while only 41.6% had an improvement in their mental health 6 months after surgery. Škodová *et al.* [20] reported physical improvement in 40% of patients and mental improvement in 36% of patients at 12 months after surgery. The percentage of patients in our study that showed improvement is higher than that described by these authors. The model for the physical component explains 18% of the variance, which is not different from the results of others [21]. Our multivariate analysis model for the mental component revealed a weakness because it only explained 6.1% of the variance. This can be explained by the fact that we did not evaluate patients for depression and anxiety, both of which have been proven to influence the outcomes of cardiac surgery. Penckofer *et al.* [22] reported that 25% of women undergoing cardiac surgery continued to express severe psychological distress 3 months after surgery. Considering that our sample was 50% female, this may have influenced the mental health results. We could also verify that the percentage of patients that get worst in the physical component, 10%, is much less than 27% in the mental one. These can be explained by the unavoidable mental deterioration of our elderly population that probably can be accelerated by a major procedure, such as cardiac surgery.

We conducted a prospective and highly controlled study with the final sample being 88.7% of the initial number included. Only patients undergoing elective surgery were included, eliminating the possible bias induced by urgent and emergent patients who have shown worse outcomes and mortality [5, 6]. The sample was 50% male and included procedures with different complexities, such as isolated coronary or valve surgery as well as combined valve and coronary surgery. Almost two-thirds of patients underwent isolated valve surgery, which is different from other studies with predominantly ischaemic patients. Previous studies frequently report lower preoperative test results that evaluated the quality of life in women; however, when analysing an improvement, most reports do not show evidence of significant differences [23]. The implication of the procedure type on health improvement is not unanimous in the various published studies. Some authors report no differences, and others suggest that patients undergoing valve surgery recover better than those undergoing coronary surgery [17, 23]. In our study, the sample characteristics may have influenced the results, but we could not find differences in procedure or sex that were significant on the physical component results at 12 months after surgery. We used the SF-36, which is a validated test for the Portuguese population and is a reproducible, reliable and recommended general health test in cardiac surgery, to evaluate the quality of life [6, 7]. The SF-36 is a generic health test that

has advantages over disease-specific tests. Generic tests allow to compare different diseases as well as treatment gains and to measure the interdependence between health dimensions, for instance, influence of cardiovascular disease on mental health [24]. All patients included in the study underwent a preoperative evaluation, and missing data were managed according to the recommendations [5, 6, 14].

The studies on quality of life in elderly patients after cardiac surgery are often retrospective, have different age definitions for elderly patients, include many types of procedures, use non-validated tests and have a loss to follow-up rate of more than the 15% limit for ideal treatment received analysis [5, 6]. The heterogeneity in methodology makes comparisons between studies difficult and weakens the possible conclusions that may be drawn from systematic reviews. We used a methodology designed to overcome most of the weaknesses of the previous studies, following criteria suggested by Noyez *et al.* [7] for studies on quality of life in cardiac surgery.

To maximize health gains, cardiac rehabilitation is recommended after valve and coronary surgery, especially for patients who have had previous episodes of heart failure [25]. Unfortunately, cardiac rehabilitation is still infrequently used due to multiple barriers [26]. The questions that remain concerning cardiac rehabilitation relate to which patients can benefit most from it and the best timing for its implementation [27]. Our study helps to answer these questions. First, we identified the first 3 months after surgery as the period when the most improvement occurs, and second, we identified the patient characteristics that impact physical and mental health results. These 2 findings should be considered when implementing rehabilitation programmes in the future. Based on our results, we are also able to counsel patients better and manage their expectations before surgery. Multicentre studies focusing on elderly patients that use the correct methodology and include an evaluation for anxiety and depression as well as frailty will most likely enable the development of better predictive models for this population [28, 29].

We can recognize as a weakness of our study the fact that we did not consider the impact of surgery on survival improvement, which exists because our sample includes patients older than 65 years but Portuguese life expectancy for women is 84.3 and for men it is 78.1. However, the focus of our study was on quality of life as an outcome. Another possible limitation of our study is the application of a general health test based on the perceptions of patients, repeated at 4 time points, rather than using a cardiovascular-specific evaluation test. However, SF-36 has been proven to be a reliable test for the evaluation of cardiovascular disease, and it is used in the majority of cardiac surgery studies [30]. Caution should be exercised when extrapolating these results to other populations as these results are from a single centre with specific acceptance criteria for surgery. About one-quarter of patients have a decline in their mental health at 12 months. This is an important finding as it raises the issue of what relationship may exist between cardiac surgery and the onset of dementia. Documenting in a more complete way and understanding this potential relationship are topics for future research as it is out of the scope of the current study. Finally, a larger sample size could lead to more precise conclusions.

CONCLUSION

In conclusion, elective cardiac surgery improves the quality of life in patients older than 65 years, with better postoperative results in all SF-36 dimensions, as well as in summary physical and mental measures. The highest improvement occurs in the first 3 months following surgery. Poor preoperative physical health, older age, female sex and longer length of hospital stay all had a negative influence on physical health. Poor preoperative mental health status and intensive care length of stay had a negative impact on mental health outcomes. To achieve better results, rehabilitation programmes and patient counselling should take into account this pattern of improvement throughout the first 12 months after surgery.

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Conflict of interest: none declared.

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